TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNOLOGIES TO QUANTIFY THE FLUX OF CONTAMINANT FROM HANFORD GROUNDWATER TO THE COLUMBIA RIVER

Identification No.: RL-SS35
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): Broad need potentially applicable to multiple operable units.
PBS No.: RL-SS04 (RL-VZ01)
Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X 1. Critical to the success of the ACPC
___ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
___ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Technologies to Quantify the Flux of Contaminant from Hanford Groundwater to the Columbia River

Need/Opportunity Category: Technology Need

***Need Description*:** This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an "integrated" need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this "integrated" need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an "integrated" need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG

Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This need focuses on the delivery of contaminants from the groundwater to the river. Re-examination of boundary conditions and boundary fluxes was a key recommendation of the recent peer review of the Hanford Site-wide groundwater model. The necessary technologies and approaches focus on the distal portion of the Hanford groundwater plume. Information collected will provide robust information on contaminant releases and provide a sensitive system for monitoring the arrival of contaminants. This technical approach minimizes the artifacts associated with changing river stage and will improve the groundwater release estimates used in the Hanford site-wide groundwater model and its integration into the SAC and enhance stakeholder credibility.

Specific issues that need to be addressed to resolve this technical gap include techniques to measure overall contaminant fluxes from the groundwater to the river. The techniques should be designed so that they will not be significantly impacted by the transient effects and measurement artifacts associated with the river stage. They are needed to provide a better estimate of contaminant flux. These techniques should provide representative monitoring data and depth discrete information on contaminant distribution and flux in the aquifer near the river. Additionally, techniques are needed to assess the representativeness and quality of these depth discrete groundwater monitoring methods. These needs focus on determining how contaminants discharge to the river – along the shoreline, in the bed of the river, and how far out into the river – and determining how these discharges are affected by daily and seasonal variations of river stage.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with quantifying contaminant flux is needed in the FY05 timeframe to meet these objectives.

***Problem Description*:** This need falls under the Groundwater Technical Element within the S&T Endeavor. The Groundwater Technical Element is intended to address and resolve scientific issues related to understanding the role of groundwater in the overall migration of contaminants from the Hanford Site. The objective of the Groundwater Technical Element is to enhance protection of the Columbia River and its environs by 1) determining the existing distributions of contaminants with particular emphasis on 3D distribution especially at the interfaces with the vadose zone and the river and 2) enhancing the understanding of geological, chemical, geochemical, and hydrologic controls for future movement of contaminants. Detection of contaminants in groundwater monitoring wells underlying tanks, cribs, landfills, and other sources has often been the first indication of releases and migration. Understanding the flux and dynamics of vadose-capillary fringe-groundwater contaminant transfer and plume migration in

three dimensions is critical to reconstructing vadose zone transport. On a larger scale, transport processes in groundwater control migration to extraction wells or surface water bodies (e.g., the Columbia River), define future risk scenarios, and affect the potential for optimized cleanup. An implicit goal of this research is to provide sufficient knowledge and data and identify existing and new S&T for input to DOE's decision-making process for Hanford cleanup.

This technical element provides the information, analytic capabilities, and understanding required for improving the technical basis for assessments of Hanford Site impacts to groundwater resources and the Columbia River. Groundwater represents an important portion of the potential exposure path and is the link between the source/vadose system and receptors at a well or the river. The technical scope of the groundwater element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. The technical scope of the groundwater element also compliments that of the river element by providing input to contaminant flux to the river and other interactions between the groundwater and Columbia River. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology, geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants.

Benefit to the Project Baseline of Filling Need: The information generated to address this need will provide high quality estimates of contaminant flux and provide a sentinel (early warning) system for future contaminant arrival. The robustness and defensibility of the data will provide the basis for efficient and optimized remedial actions. The activity that this need supports will be used to support development of site-specific assessments as well as the SAC as part of the GW/VZ Integration Project. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

***Functional Performance Requirements*:** The techniques applied or information that is obtained must quantify the contaminants flux to the river such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project. The information must provide an accurate understanding of current conditions, and the ability to assess potential future conditions for near- and long-term scenarios.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4 ***TIP No.:*** TIP-0014

Relevant PBS Milestone: PBS-MC-042

***Justification For Need*:**

Technical: There is an insufficient understanding of the horizontal location, vertical structure, and location of the groundwater contamination as it approaches and enters the Columbia River. This information is necessary to document the near-river transport path of contaminant plumes to the receptor and will be used by the site-wide groundwater model and its integration into the SAC.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

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Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II; Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

River Element Index to Linked Needs.

RL-SS36	Provide means to integrate regional-scale phenomena into assessments of contaminant transport and impacts within the Columbia River.
RL-SS37	Provide methodology to relate information derived from sitewide-scale groundwater flow modeling to the various scales associated with assessing impacts in the river environment
RL-SS38	Understand, quantify and develop descriptions of transport and transformation of groundwater-derived contaminants of concern in the river
RL-SS39	Understand and Provide Means to Quantify the Impacts of River Contamination on Receptors